HABby Clam Card Game: Lesson Plan

Overview

How do harmful algae impact seafood safety? Clams and other organisms that eat the toxic phytoplankton Alexandrium can accumulate toxins in their tissues. Marine mammals, birds, or people that eat toxic clams can become sick. Seafood sickness caused by Alexandrium is known as "Paralytic Shellfish Poisoning." In this activity, students will become hungry clams and will track how their toxicity changes as they eat different phytoplankton. By simulating this process through gameplay and analyzing the results, students will gain a deeper understanding of how harmful algal blooms can impact seafood safety.

Objectives

- Learn about harmful algae and their impact on seafood safety
- Learn about the HAB poisoning syndrome known as paralytic shellfish poisoning
- Explore ways that algal toxins enter the food web and persist over time
- Consider how different environmental conditions shape algal blooms
- Develop skills in recording, calculating, graphing, and interpreting data
- Draw connections between algal blooms, toxin accumulation in seafood, and human health

Duration and Level

This activity is designed to take ~60 minutes to complete. Additional reflection questions can be used to extend the lesson. This activity is targeted to middle or early high school students (grades 7-9), but can be adapted for other grades.

Preparation

Background

Students should come to this activity with a basic understanding of what algal blooms are and ways that they can be harmful. Prior to the activity, students should be able to answer the following:

- What are phytoplankton?
- What is a bloom?
- What is a harmful bloom? Are all blooms harmful?

Before beginning the activity, students should also be introduced to the concept that *Alexandrium* is a harmful algal bloom organism that creates toxins. These toxins build up in clams or other creatures that eat the algae, and can cause paralytic shellfish poisoning in people who eat the toxic clams. (See Background Resources below for additional context and graphics; consider adapting one or more of these readings as a homework assignment before class).

Background Resources

- **What are HABs?** https://ahab.aoos.org/what-are-habs/
- **What is Paralytic Shellfish Poisoning?** https://www.polartrec.com/expeditions/harmful-algal-blooms-in-arctic-waters/journals/2022-07-19
- **Alexandrium Facts** https://hab.whoi.edu/species/species-by-name/alexandrium/
- **Food Web Graphic**: https://tos.org/oceanography/assets/images/content/35-anderson-f1.jpg

Activity Materials

- **Phytoplankton Cards** - Print one set per group. This template is designed to be printed on business card cardstock (e.g. Avery 5371). Alternatively, the educator can print on 8.5 x 11 paper and cut out the cards (ask the students to help with this).
    - Separate each set of cards into 2 decks: one for all *Alexandrium* (*Alexandrium* deck), and one for all other phytoplankton (main deck).
- **Data Sheets** - Print one per student.
- **Instructions** - Print one per group, or per student.
- **6-sided dice** - One per group.
- **Assorted color markers or pencils.**

Activity Instructions

In this activity your students will become clams, consuming plankton over the course of several months across three separate years. We offer three scenarios (warm summer, cold summer, and warm spring) to simulate algal toxin accumulation under different environmental conditions. If you are short on time, you can choose to omit one of these. Alternatively, if you have extra time you can invent additional scenarios or invite the students to create their own. We recommend familiarizing yourself with the different bloom scenarios and the gameplay ahead of time by playing a practice game solo or with a friend or family member. The game is optimized for up to 8 students, so depending on your class size you may want to split your students up into groups. When getting started, we recommend that the educator narrate the first several turns step by step before allowing students to continue the game independently.

For Each Year:

1. Guide the students through drawing their starting cards according to the instructions for that year.
2. Follow the instructions to create the starting "plankton bloom," which is the set of facedown cards that should sit in the center of each group.
3. Once the game is set up, begin taking turns (each turn = 1 month).

Sequence of Actions for Each Turn:

1. **Poop**: Each student discards ("poops") two plankton, these should be selected *randomly* from their deck without looking at the cards.
2. **Grow the Bloom**: As a group, the students should follow instructions to remove and add cards from the decks to the plankton bloom (these will be different each year). Make sure to mix up all the cards in the pool face-down so that no one can see!
3. **Eat**: Each student draws ("eats") two plankton by picking cards randomly from the plankton bloom.
4. **Record:** Students look at their cards, each student records the fraction that is *Alexandrium* on their data sheet. Convert this fraction into a percent.
5. **Roll for Harvest:** Check to see if there is a ⚄ symbol next to the name of the month. Have the group roll the dice once for each ⚄. If there are no ⚄, do not roll. Once a 6 is rolled, this signifies that your clams have been harvested. At this point, the year is over. If no sixes are rolled, the harvest happens in November.

Harvest Time: Once a 6 is rolled, the clams have been harvested. Have your students refer to the toxicity table on their datasheet to determine what symptoms their clam would give to a person that ate it. For example, a student whose hand contains 6 *Alexandrium* out of 10 total cards (6/10) is at 60% toxicity (a group review of converting fractions to percents may be helpful before starting the game). Refer to the table, which says that clams that are 41-60% toxic can cause dizziness or numbness in fingers and toes. At this point you can move on to the next year, or to the reflection portion of the activity once all years have been completed.

Year 1 (Cold Summer): Each student should draw 10 starting cards from the main deck. Start with a center bloom of ~20 cards from the main deck. Each month, remove 5 random cards from the bloom and add 2 cards from the *Alexandrium* deck and 3 cards from the main deck.

Year 2 (Warm Summer): Each student should draw 10 starting cards from the main deck. Start with a center bloom of ~10 cards from the main deck and ~10 cards from the

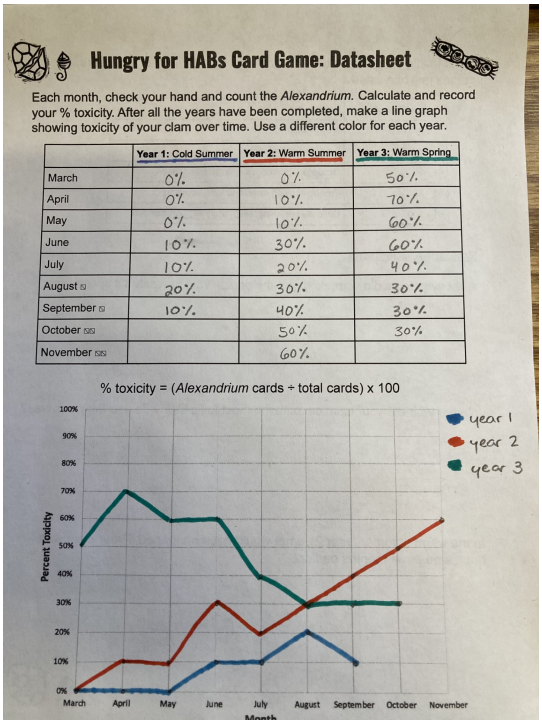
Alexandrium deck. Each month, remove 5 random cards from the bloom and add 5 cards from the *Alexandrium* deck.

Year 3 (warm spring): Each student should start with 5 cards from the *Alexandrium* deck and 5 cards from the main deck (10 total). Start the center bloom with ~20 cards from the *Alexandrium* deck. Each month, remove 5 random cards from the bloom and add 5 cards from the main deck.

Reflection

After all years have been completed, students can use their datasheet to plot their clam's toxicity in each year. Use different colors to represent different years on the same graph (see example below). Students can then complete the reflection questions independently, this can even be done as homework. If there is time, we suggest a broader class discussion. Some additional reflection questions to ask the class might include:

- In each year, what time of year was safest to harvest?
- Who in the class got the most toxic clam? What symptoms did it give?
- How can harvesters make sure that their clams are safe to eat? (This could lead into a discussion and some additional information about toxin testing)



Hungry for HABs Card Game: Datasheet

Each month, check your hand and count the *Alexandrium*. Calculate and record your % toxicity. After all the years have been completed, make a line graph showing toxicity of your clam over time. Use a different color for each year.

	Year 1: Cold Summer	**Year 2:** Warm Summer	**Year 3:** Warm Spring
March	0%	0%	50%
April	0%	10%	70%
May	0%	10%	60%
June	10%	30%	60%
July	10%	20%	40%
August	20%	30%	30%
September	10%	40%	30%
October		50%	30%
November		60%	

% toxicity = (*Alexandrium* cards ÷ total cards) x 100

Extension

To adapt this lesson for older students, consider having the class combine their data together, perhaps through a collaborative spreadsheet. Calculate the maximum, minimum, and mean toxicity for different months of each year. Consider plotting the class data together using error bars to visualize the spread of the dataset.

As a cultural extension, learn about different methods of harvesting clams. In some communities, clams are dug up from the intertidal using rakes or by hand. In other regions, such as northwestern Alaska, clams are harvested from the beach when they are washed up by storms. What are the rules around harvesting clams in your region? Are local toxin testing resources available to your community? Are there other organisms besides clams that might contain paralytic shellfish toxins? These are just some example questions you might dig into with your students following this activity.

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